

REMARKS

Claims 9-20 are in the application and undergoing prosecution.

Applicants have amended claims 9 and 15 by deleting the term "comprising" and using in place thereof the term "consisting essentially of". This language will exclude any nanofibers other than those defined in said claims. For example, graphitic nanostructures wherein the graphite platelets are aligned perpendicular to the longitudinal axis are excluded from the instant claims.

Rejection Under 35 U.S.C. 102(b) and in Alternative 103(a).

Claims 1-5, 9-11, and 15-17 have been rejected under 35 U.S.C. 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as being obvious over the Audier et al. article.

Examiner's Position

It is the Examiner's position that Audier et al. teach, on pages 220-221 and 223 conical-faceted shaped nanotubes, which are crystalline. The Examiner states that although the product is not described identically, no difference is seen due to the similarity in synthesis and structure reported. The Examiner continues by saying that the surface groups are present by virtue of the well known reactivity of edge groups with air. The Examiner in his comments on applicants' response to the First Office Action states that the claims do not exclude planes stacked perpendicular to the fiber axis.

Applicants' Position

It is still applicants' position that the graphite nanostructure materials defined in instant claims 9 through 20 are not anticipated by, nor obvious in view of, the Audier et al. article. The graphitic nanostructure that is defined in instant claim 9 is a graphitic nanostructure generally represented by Figure 1c hereof, which applicant sometimes refers to as a "ribbon" structure. Applicants have included the language "consisting essentially of" to exclude all structures other than the structures wherein the graphite platelets are aligned substantially parallel to the

longitudinal axis of the nanofiber. The conditions of Audier et al. are not capable of producing the claimed nanostructures, primarily because Audier et al. does not produce carbon nanostructures using a mixture of CO and H₂. Instead, Audier et al. use only CO. Applicants have unexpectedly discovered that CO, without H₂, cannot produce the nanostructures instantly claimed.

Applicants submit herewith a Declaration Under 35 U.S.C. 1.132 by Dr. Baker that contains data showing the unexpected results obtained using a mixture of CO plus H₂ instead of CO alone for producing the graphitic nanostructures of the presently claimed invention. When the Fe:Ni catalyst of Audier et al. was used in the presence of only CO no multifaceted nanotubes were produced. Instead, so called "fibrils" which are cylindrical and not multifaceted, were produced.

Therefore, in view of the above, applicants request that the Examiner reconsider and withdraw this rejection.

First Rejection Under 35 U.S.C. 103(a)

Claims 5-8, 11-14, and 17-20 are again rejected under 35 U.S.C. 103(a) as being unpatentable over Audier et al. taken with Kaner et al.

Examiner's Position

The Examiner contends that Audier et al. does not explicitly teach surface groups, however Kaner teaches introducing groups to functionalize nanofibers to make them more useful. The Examiner points to column 10 and takes Official Notice that the claimed groups are old and known and described as groups on carbon nanofibers.

Applicants' Position

Applicants repeat their earlier argument that Kaner et al. teach the synthesis of carbon materials having at least a partially curved structure, such as nanotubes, encapsulated metal, or a combination thereof. Kaner et al. define, in column 3, lines 18+ "partially curved structure" to

mean a structure having a non-flat carbon based structure, such as found in nanotubes. The nanostructures of Kaner et al. are produced by a displacement reaction, preferably a double displacement (solid-state metathesis) reaction in which a carbon compound, such as a hydrocarbon, halogenated hydrocarbon, or halogenated carbon compound and a metal compound are metathetically reacted in the presence of a catalyst. The reaction takes place at about 2000°C or more, which is far outside the range for producing "ribbon" or "multifaceted" graphite nanostructures. There is no suggestion of so-called "ribbon" or "multifaceted" structures as instantly claimed.

Further, the claims with limitations to functional groups are dependent on claims that applicants regard as patentable over the art and thus are patentable as well.

Applicants again direct the Examiner's attention to the Declaration under 35 U.S.C. 1.132 accompanying this response that shows that only when H₂ is used with CO with certain catalysts of the instant invention, can one obtain the instantly claimed graphitic nanostructures.

Therefore, applicants request that the Examiner also reconsider and withdraw this rejection.

Second Rejection Under 35 U.S.C. 103(a)

Claims 9-11, 13-17, 19, and 20 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Rodriguez et al. US 5,653,951.

Examiner's Position

The Examiner argues that Rodriguez et al. teach, in columns 3 and 11 what appears to be the same product as that instantly claimed. The Examiner continues by saying that choosing the top have in planes aligned with the fiber axis is an obvious expedient, as suggested by the Rodriguez et al. The Examiner also states that surface groups are present by virtue of the well known reactivity of edge groups with air.

Applicants' Position

It is applicants' position that the structure referenced in U.S. Patent No. 5,653,951 as being "straight" does not refer to the alignment of the graphite platelets of the nanofiber, but to the overall geometric shape of the nanofiber. Any graphite nanofiber will have an overall geometric shape and it will have an alignment of graphite platelets that comprises the nanofiber. That is, nanofibers of any platelet alignment can have an over geometric shape of straight, even when the platelets are aligned substantially perpendicular to the longitudinal axis of the nanofiber. In the '951 patent the term "straight" refers to straight nanofibers having platelets that aligned perpendicular to the longitudinal axis of the nanofiber. Applicants enclose herewith U.S. Patent No. 5,149,584 having the same inventive entity as the instant application which contains photomicrographs of some of the geometric shapes that a graphite nanofiber can have. Even though the micrographs show overall branched, spiral or helical shapes (straight nanofibers are not illustrated in the '584 patent), the individual platelets can be aligned in any geometric pattern.

Again, the accompanying Declaration shows that only when a combination of CO and H₂ are used with an Fe:Ni and Fe:Cu catalyst can one obtain the nanostructures as instantly claimed.

Applicants again direct the Examiner's attention to the Declaration accompanying this response.

Applicants request that the Examiner reconsider and withdraw this rejection.

Third Rejection Under 35 U.S.C. 103(a)

Claims 9-11, 13-17, 19 and 20 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Baker et al. US 5,618,875.

Examiner's Position

The Examiner argues that Baker et al. teach in column 11 what appears to be the same product as that instantly claimed. The Examiner further states that choosing to make the planes

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parallel to the fiber axis is an obvious expedient, as it is suggested by the Baker et al. The Examiner again states that the surface groups are present by virtue of the well known reactivity of edge groups with air.

Applicants' Position

It is applicants' position that the disclosure of Example 7 in column 11 of U.S. Patent No. 5,618,875 does not refer to the same type of nanofibers as instantly claimed. When nanostructures were made with Fe on a support to produce a nanofiber wherein the graphite platelets were aligned "substantially parallel" to the growth axis of the filament, the nanostructure was a cylindrical tubular structure. The Declaration submitted herewith shows that the use of bulk Fe with a mixture of CO/C₂H₂/H₂ produced platelet nanofibers whereas cylindrical tubular nanofibers are produced when the Fe is supported and used with the same carbon-containing gas system. This is similar to the method taught in U.S. Patent No. 4,663,230 to Tennent wherein supported Fe is used to produce his so-called "fibrils" which are substantially cylindrical nanotubes. Cylindrical nanotubes are composed of platelets that are parallel to the longitudinal axis of the nanofiber, but the platelets structure is not multifaceted nor ribbon.

Therefore, applicants request that this rejection also be withdrawn.

In view of the above, it is applicants' position that the claims, as now amended, define a patentable invention over the art. Therefore, applicants request that the Examiner pass this application to allowance.

Respectfully submitted,

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